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(71)Applicant : **SEIKO EPSON CORP**

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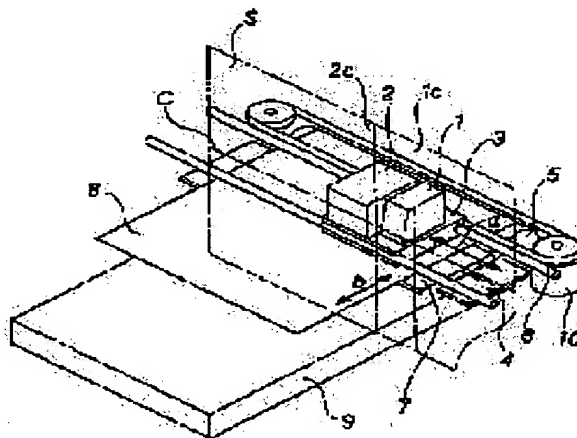
(72)Inventor : **HOSHINO MASARU**

(54) INK JET RECORDER

(57)Abstract:

PURPOSE: To realize a recorder which always preferably records a recording medium even if ink oozing characteristics of the medium are different without particularly using a test recording sheet or area.

CONSTITUTION: A test pattern recording position is set externally of data recording area by a recorder having a recording head 2 and test pattern image detecting means 1, a fine test pattern is recorded at the set position, a recorded test pattern image is detected by the means 1, recording conditions are regulated according to a detected result, and recording data is recorded on the medium 8 recorded with the previous pattern image by the head 2.



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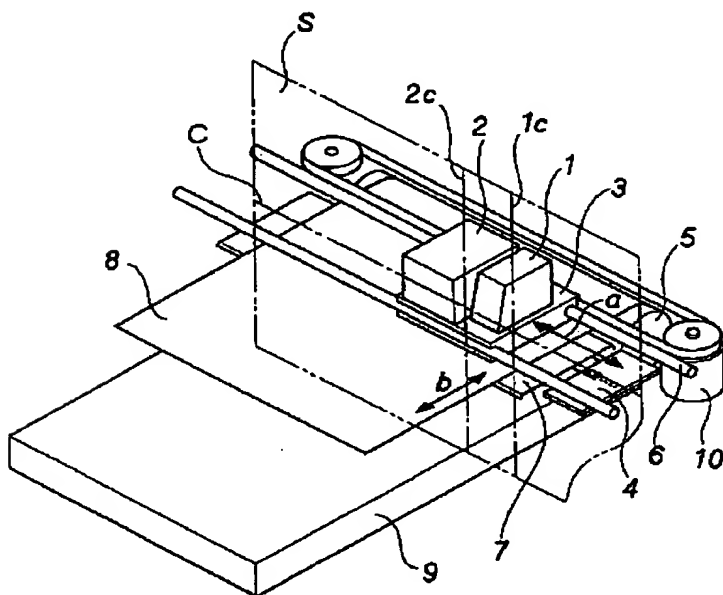
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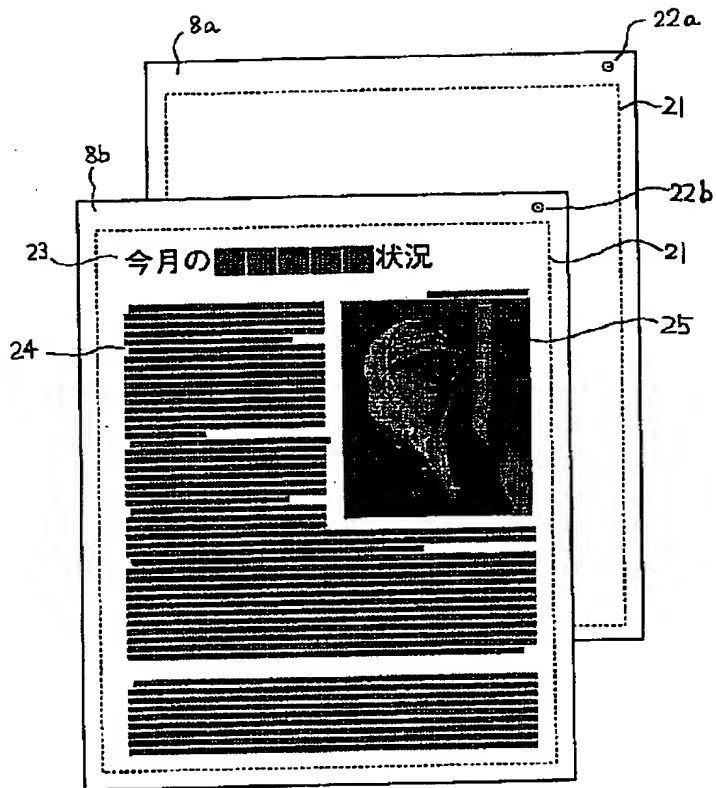
DRAWINGS

[Drawing 1]

- | | |
|------------------------------|----------------|
| 1: センサユニット (テスト
パターン検出手段) | 5: 紙送りローラ |
| 2: 記録ヘッド | 6: キャリッジガイド |
| 3: キャリッジ | 7: フラテン |
| 4: 校正板 | 8: 記録紙 (記録媒体) |
| | 9: 紙カセット |
| | 10: キャリッジ送りモータ |

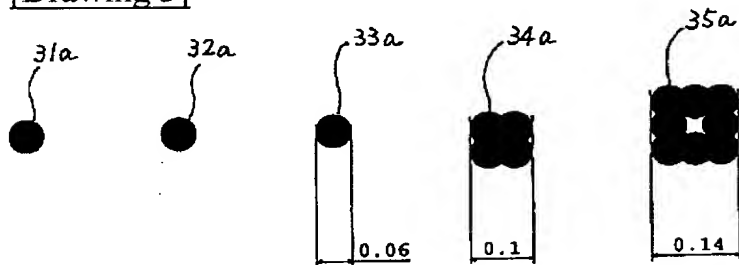


[Drawing 2]

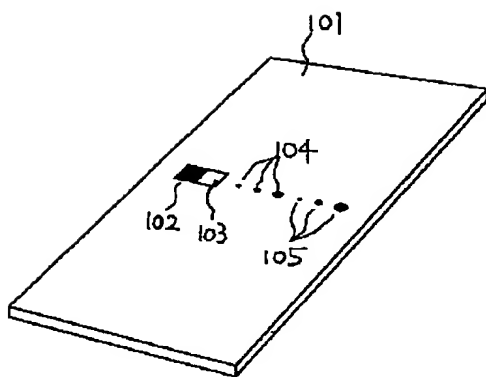


- 8 a : 記録紙 (テストパターン記録直後)
- 8 b : 記録紙 (データ記録後)
- 2 1 : 記録領域
- 2 2 a : テストパターン記録位置 (テストパターン記録直後)
- 2 2 b : テストパターン記録位置 (データ記録後)
- 2 3 : 文字記録部分
- 2 4 : 文字記録部分
- 2 5 : 画像記録部分

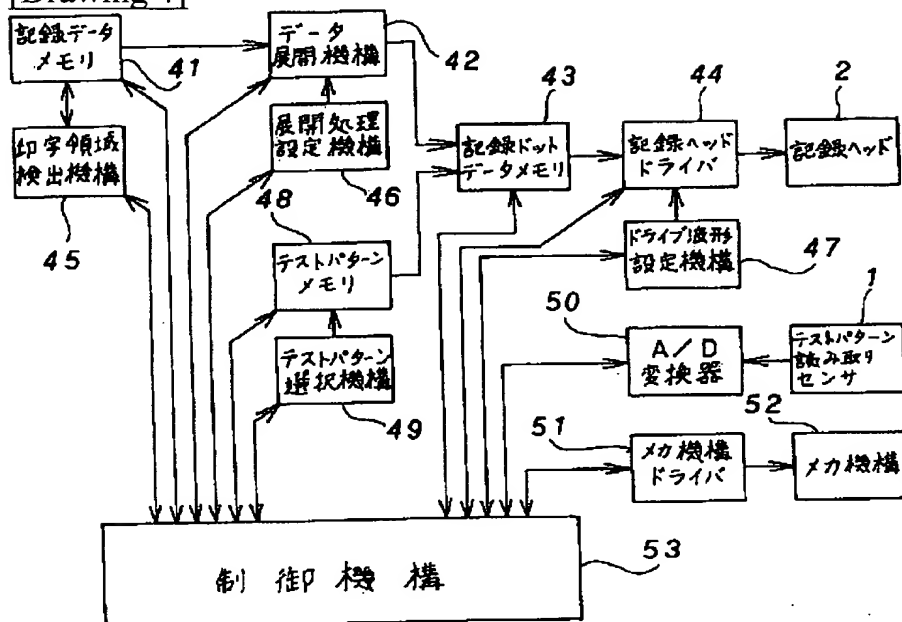
[Drawing 3]



[Drawing 10]

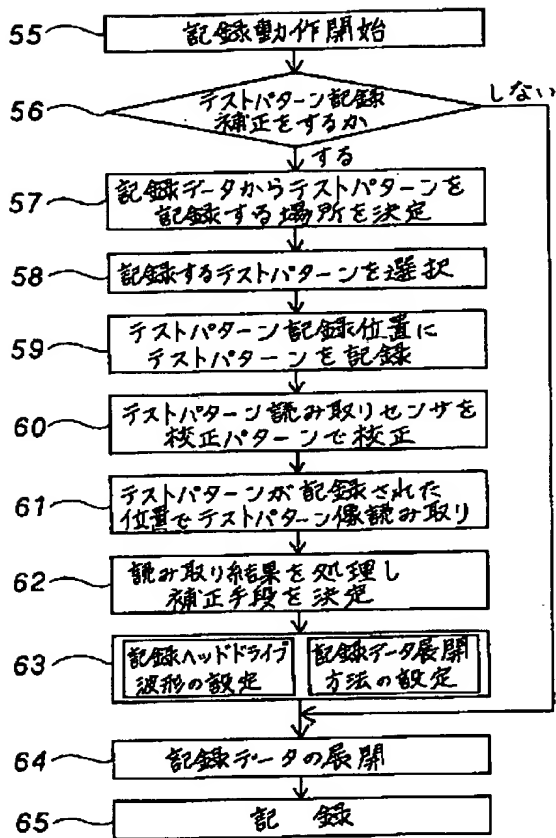


[Drawing 4]

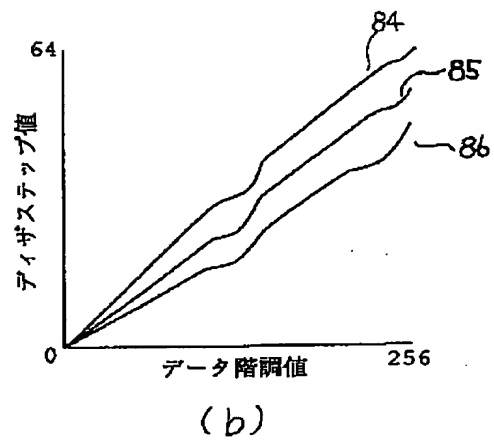
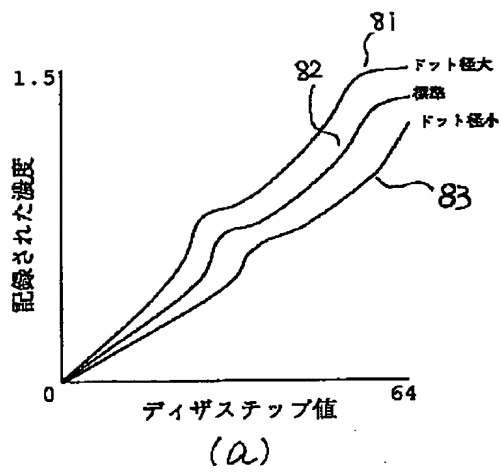


[Drawing 5]

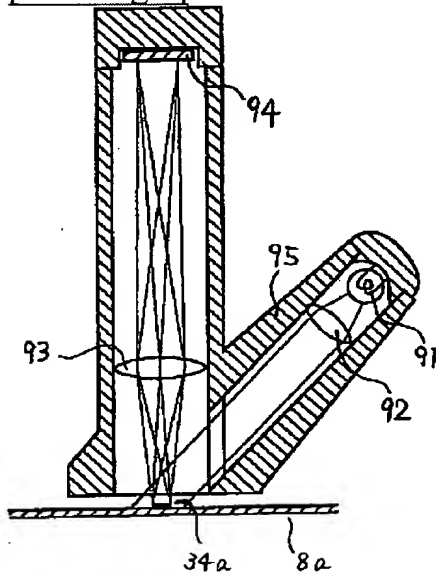




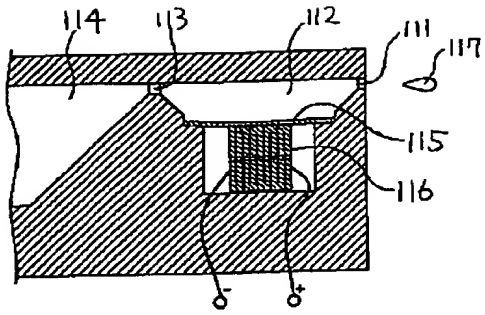
[Drawing 7]



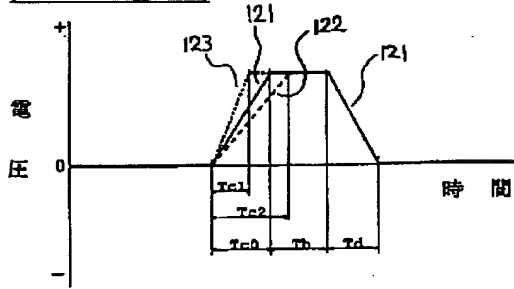
[Drawing 8]



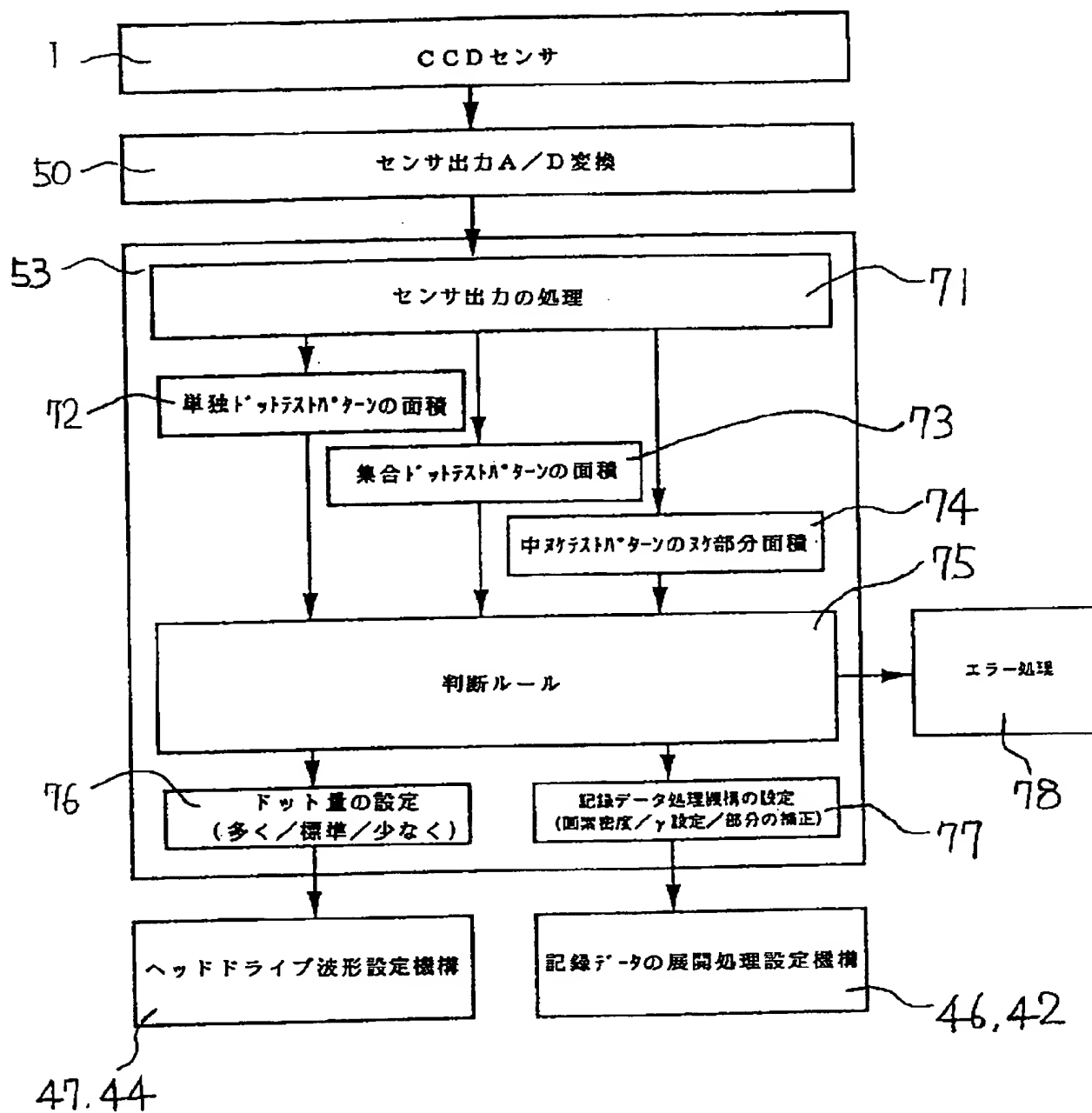
[Drawing 11]



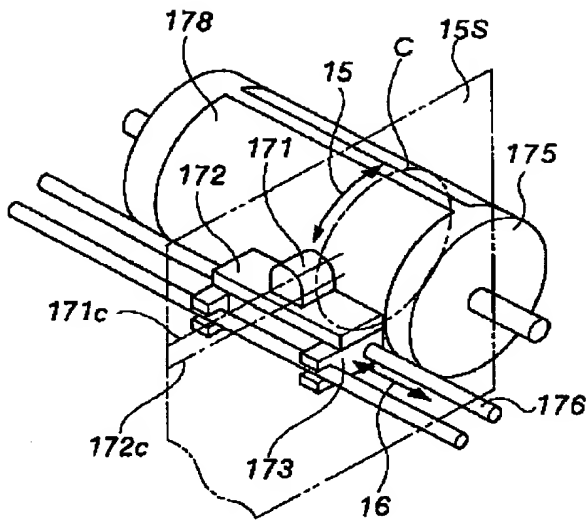
[Drawing 12]



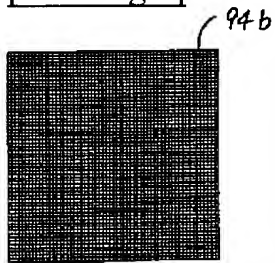
[Drawing 6]



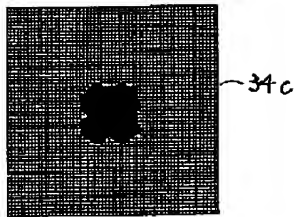
[Drawing 17]



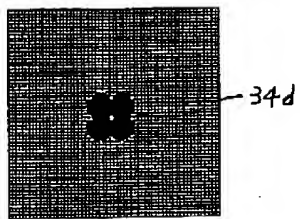
[Drawing 9]



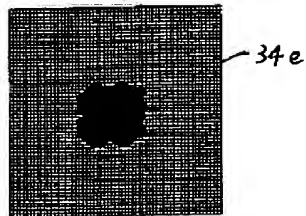
(a)



(b)

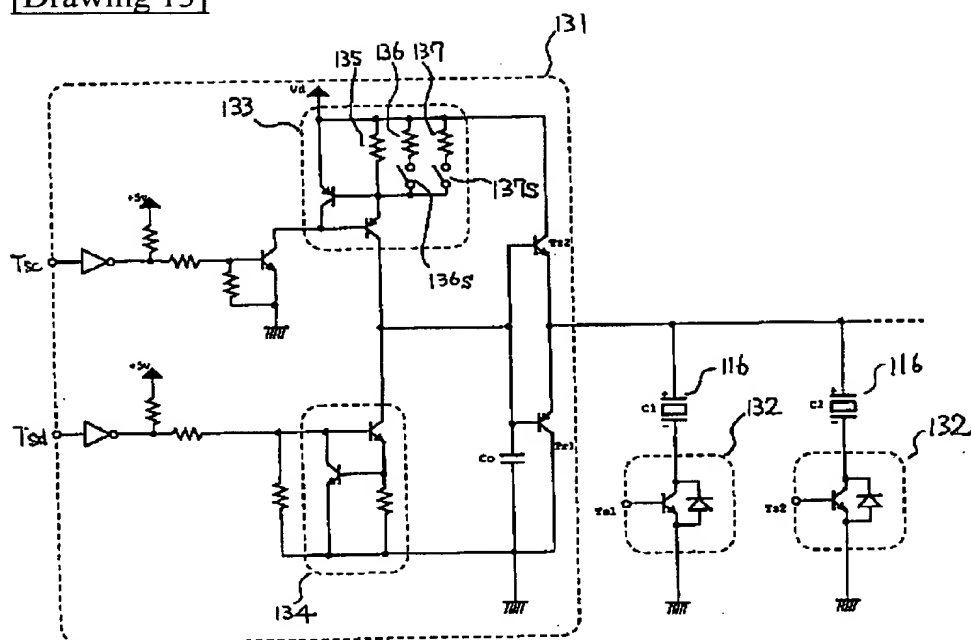


(c)

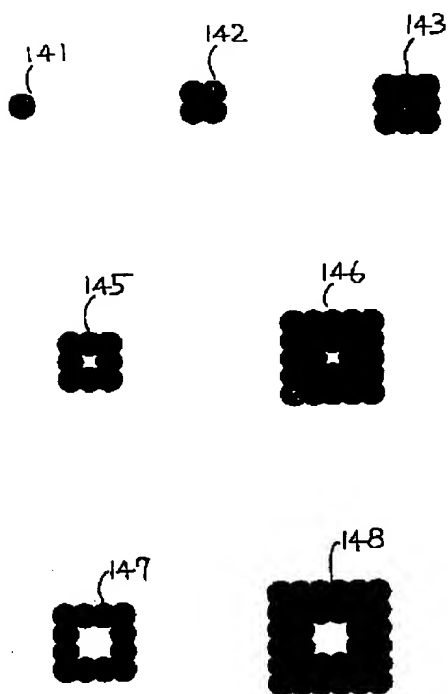


(d)

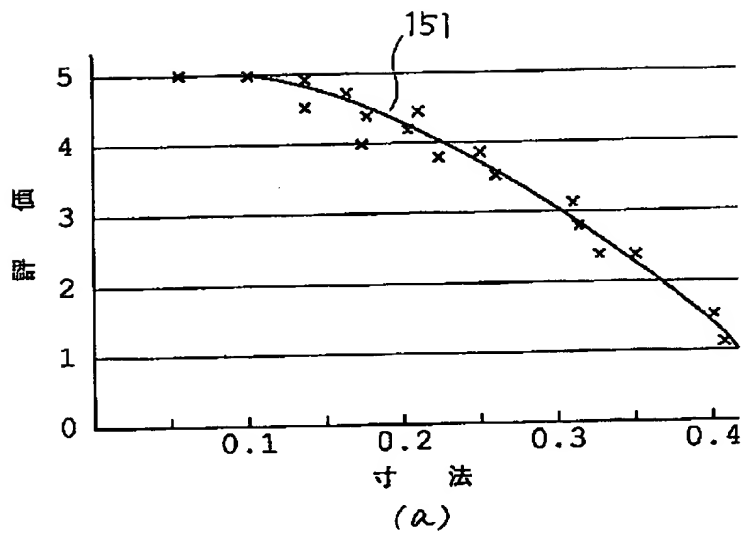
[Drawing 13]



[Drawing 14]



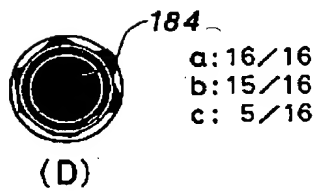
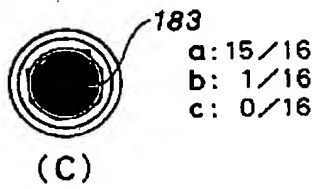
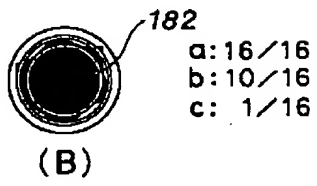
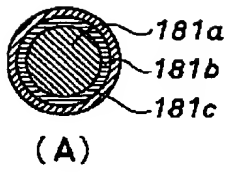
[Drawing 15]



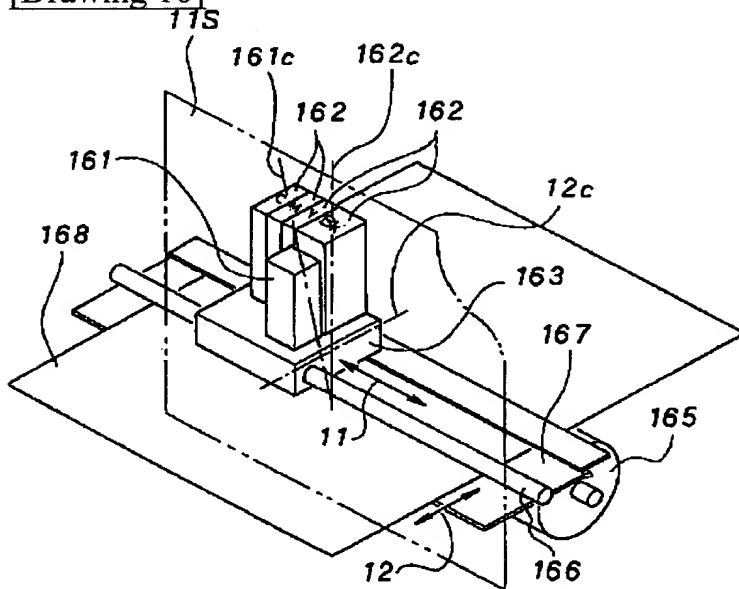
パターン	概寸法mm	発見率 (%)	評価 (5段階)
141	0.06mm	0	5.0
142	0.10mm	0	5.0
143	0.14mm	7	4.9
145	0.14mm	14	4.5
147	0.18mm	42	4.0
146	0.23mm	53	3.8
148	0.27mm	88	3.5

(b)

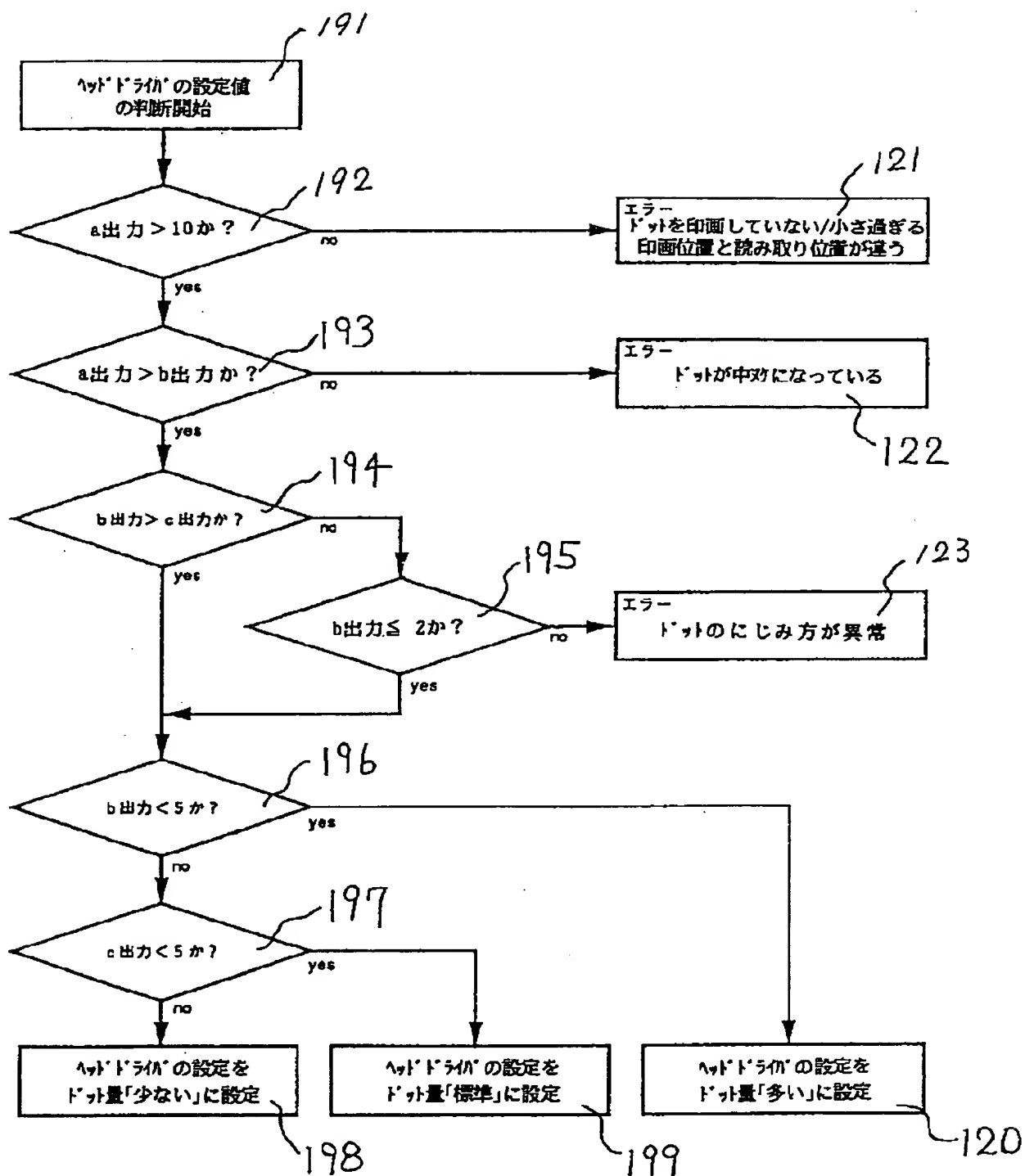
[Drawing 18]



[Drawing 16]



[Drawing 19]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the ink jet recording device which is made to breathe out ink by the ink jet component, and records an alphabetic character and an image on a record medium.

[0002]

[Description of the Prior Art] The recording device by the ink jet method begins to spread from it being the low noise as compared with the printer of an impact dot method, and is spreading quickly from a miniaturization and low-pricing having progressed in recent years. Moreover, the needs of color record are increasing with substantial computing environment, and since the addition of the head which records color ink, such as yellow, a Magenta, and cyanogen, in addition to black can realize a color recording apparatus comparatively easily, the recording apparatus by the ink jet method attracts attention.

[0003] High definition-ization of an ink jet recording device is expected in the above situations. In the recording device, the factor of image quality is made important [resolution, gradation nature and three color reproduction nature]. Although a current color ink jet recording device has many which use four colors of black, yellow, cyanogen, and a Magenta for ink by dot density 300 - 400dpi and images, such as an alphabetic character and easy drawing, show the image quality of practical use level, the image containing much gradation, such as a picture and a photograph, is still inadequate image quality.

[0004] The image quality of an ink jet recording device is greatly influenced by the property of a record medium. Although the ink jet recording apparatus manufacturer recommends the good exclusive paper of image quality, since the paper only for ink jets being expensive and a general office form differ from texture, a user uses a common office form in many cases. In addition to the image quality of the record using the office form as a practical trouble being inferior here, it is mentioned that image quality changes greatly also with classes of office form. In image parts on which this is because how in

which ink bleeds in paper differs, distributes compared with the alphabetic character part on which a dot is recorded continuously, and a dot is recorded, such as a picture and a photograph, record concentration and a color are the factor which it differs from it of record data greatly, and reduces image quality.

[0005] Therefore, in order to solve the trouble described above, a test record is performed before record as shown in JP,2-3327,A, and approaches, such as amending by detecting the blot degree of ink by reading the image recorded the account of a test, are devised.

[0006] However, by the conventional approach, there was a problem that it will be restricted when special, in case a test pattern may be recorded in the case where a test form may be used, or a printing object, as an object for test records.

[0007]

[Problem(s) to be Solved by the Invention] Therefore, the technical problem which this invention tends to solve is realizing the practical recording device which is not based by enabling detection of a test record and a test-record result, and record condition adjustment by the detection result also in the general record which can use neither a test form nor a test field on the property of record media, such as quality of paper, but raises record quality.

[0008]

[Means for Solving the Problem] In order to solve such a technical problem, it sets to this invention. In the ink jet recording device which forms the image based on record data on a record medium by the recording head which carries out the regurgitation of the ink droplet A means for the amount of ink of 1 dot to be below 0.1microg, and to record the test pattern of minute area on the location outside the record section on a record medium, A test pattern image detection means to detect the concentration or the surface-integral cloth of said test pattern recorded on the record medium, It has a means to adjust the expansion approach of a means by which the concentration or the surface-integral cloth of said test pattern obtained by said test pattern image detection means adjusts the amount of ink droplets of said recording head, or said record data. The image based on said record data was recorded on the record medium with which said test pattern is recorded.

[0009]

[Function] The test pattern of minute area is recorded on the location outside the record section on a record medium. By recording the image based on record data on the record medium with which the recorded test pattern image was detected, the amount of ink droplets or the record data expansion approach was adjusted by the detection result, and the test pattern image was recorded It becomes recordable on the conditions doubled with the property of a record medium, without using especially the form and field for test records, and the high ink jet recording device of record quality can be realized practical.

[0010]

[Example] Based on the example illustrating the detail of this invention, it explains

below.

[0011] Drawing 13 explains the configuration of the ink jet recording device manufactured as an example of this invention, actuation, and the description from drawing 1.

[0012] Record of a photograph image is also equipped with four recording heads of 128 nozzles with a possible recording apparatus, and the manufactured recording apparatus can carry out the regurgitation of black, yellow, a Magenta, and the ink droplet of four colors of cyanogen, respectively. The aforementioned recording head makes ink pressurize and breathe out by the piezoelectric device corresponding to each nozzle, and the regurgitation frequency of the recording rate of one-page A4 large form is about 3 ppm in 20kHz and recording density 600dpi repeatedly.

[0013] Structural, the recording device of this example is called the so-called serial printer, and records by moving a recording head in the direction of paper feed, and the direction which went direct. Drawing 1 explains the structure.

[0014] The carriage 3 which put the sensor unit 1 which are a recording head 2 and a test pattern image detection means has structure which reciprocates in the direction of arrow-head a by the motor 10 along with the carriage guide 6.

[0015] It is made to rotate by the motor which does not illustrate the paper feed roller 5, and paper is fed at a time to one sheet of recording paper 8 which is a record medium from the feed unit 9, and it is sent between the platens 7 and recording heads 2 which are a record location. Moreover, the recording paper 8 can be made to get mixed up in the direction of an arrow head b if needed.

[0016] The sensor unit 1 consists of the CCD component which reads the light source which illuminates the test pattern image in the record paper, and a test pattern image. The sign 4 beside a platen 7 is a proofreading plate with which the pattern for proofreading of the sensor unit 1 is printed.

[0017] It is shown in drawing 11, using as a sectional view the internal structure of the recording head 2 shown by drawing 1. Although the nozzle which carries out the regurgitation of the ink is downward in drawing 1, drawing 11 shows a nozzle 111 to the drawing right sense. Ink is filled by the nozzle 111, the pressure room 112, the ink supply way 113, and the ink tank 114, and it has structure which carries out the regurgitation of the ink of the pressure room 112 as an ink droplet 117 from a nozzle 111 by making a voltage waveform impress and transform into the piezoelectric device 116 connected to the pressure wall 115. In this example, 128 structures as shown in drawing 11 were formed about one color, and it arranges in each color 1 train.

[0018] The process which according to this invention detects a record section from the record data sent from the host computer etc., and determines a test pattern record location outside the record section on a record medium, The process which records a test pattern on said record location, the process which detects the recorded test pattern image with a test pattern image detection means, After process ** which adjusts the amount of ink droplets of a recording head or the expansion approach of record data with the detected test pattern image is performed, actual record based on record data is performed

on the same record medium with which said test pattern image is recorded.

[0019] The flow of record actuation [in / for the block diagram showing the configuration of this example in drawing 4 / this example] is shown in drawing 5 , and it explains below at a detail.

[0020] It judges whether a test pattern is recorded with the sign 56 in drawing as starting record actuation with the sign 55 in drawing 5 . Decision can also make test pattern record omit, when using the same record form as the case where especially take the approach which a user is made to choose and record quality is not needed, or usual. Moreover, decision may be performed by judging information -- whether the recording device exchanged forms -- automatically. However, since there is also almost no time amount which performs test pattern record, does not need an excessive form although the result is detected and amended, and it takes according to this invention, it may always be made to carry out test pattern record.

[0021] Next, it decides on the location which records a test pattern from record data as the sign 57 in drawing 5 shows. The record data sent from the host computer etc. are temporarily stored in the record data memory 41 shown by drawing 4 . According to the record section detection device 45, record data are interpreted in part, determine a test pattern record location outside a data storage area, and notify it to a controlling mechanism 53.

[0022] According to this invention, the part outside the data storage area on a record medium is made into a test pattern record location, but in this example, the field where data are recorded from the information on record data is detected, and a test pattern record location is determined as the part outside the record section on a record medium with software. In the case of the record medium of A4 size, the recordable field of this example is the whole surface mostly except for a several mm bottom edge structural, but since the record data sent from a host computer have the field of the margin which is almost recorded on the periphery of a record medium in no cases, record of a test pattern is possible into the part outside a data storage area.

[0023] The example of record in the record paper is shown in drawing 2 . The recording paper of sign 8a and the recording paper of sign 8b are the same, and recording paper 8a is in the condition immediately after test pattern record, and the condition on which recording paper 8b recorded the image based on record data from on the. An alphabetic character is omitted to signs 23 and 24, this example shows the part of alphabetic character record to them, and the sign 25 shows the part of image recording including halftone by it. Said record section detection device 45 has detected the field of the broken line shown 21 in drawing as a data storage area by this example. And the test pattern record location shown by 22a or 22b of drawing 2 according to a controlling mechanism 53 is set as the external upper right of a data storage area 21.

[0024] Next, the test pattern recorded as the sign 58 in drawing 5 shows is chosen. In this example, an easy test pattern and three kinds of test patterns of a comparatively complicated test pattern are stored by everything but the test pattern usually used for the test pattern memory 48 shown by drawing 4 . the test pattern optional feature 49 is alike,

is based on a user's selection or the condition of record data, and a test pattern is chosen. Only in the case of alphabetic data with easy record data etc., an easy test pattern is chosen, and especially a complicated test pattern is chosen when a user specifies, and it is also considering the report to the host computer of a test pattern image detection result, or the output to a record form as the possible configuration if needed. In explanation of this example, it is used as a test pattern which usually uses the set of the test pattern shown in drawing 3 .

[0025] Next, as the sign 59 in drawing 5 shows, a test pattern image is recorded on a test pattern record location. The controlling mechanism 53 of drawing 4 transmits the test pattern data which were chosen from the test pattern memory 48 and carried out to the record dot data memory 43, drives the recording head driver 44, and records a test pattern for an ink droplet on discharge recording paper 8a from a recording head 1 at the same time it drives the mechanism device driver 51 according to the test pattern record location determined like the point and moves a record form and a recording head to a test pattern record location.

[0026] A test pattern is recorded on the part shown in 22a outside the drawing 2 record section 21 by this example. The test pattern of this example consists of the test pattern of five parts of the signs 31a, 32a, 33a, 34a, and 35a in drawing, as shown in drawing 3 . Signs 31a, 32a, and 33a are the test patterns of 1 dot, 34a is the test pattern of the set dot of a 2 dot x2 dot 4-dot configuration, and sign 35a is the test pattern of the 8-dot configuration except the dot of the core of a 3 dot x 3-dot grid. Since the test pattern of 1 dot has a very narrow record section, if the condition of the recording paper should be recorded on an unusual part, it will produce gross errors in the detection result. Therefore, he is trying to record two or more test patterns of 1 dot as 31a, 32a, and 33a in this example.

[0027] Next, as the sign 60 in drawing 5 shows, a proofreading pattern is read and a test pattern reading system is proofread. A proofreading plate is a plate which performed coating of ceramics to the metal which printed the black proofreading pattern on the white ground as shown in drawing 10 .

[0028] Next, a test pattern image is read in the location where the test pattern was recorded as the sign 61 in drawing 5 showed. A sectional view shows the structure of the sensor unit which is the test pattern image detection means of this example to drawing 8 . The sign 95 in drawing is the tubed frame fabricated by black resin, and arranges the illumination system and the sensor system to the interior. The illumination light from the light source 91 is made into ** parallel light with a lens 92, recording paper 8a is illuminated, and the image of recorded test pattern image 34a is projected on the CCD component 94 with a lens 93. The CCD component used by this example shall have 3600 sensor pixels in the grid-like field of 60x60, as drawing 9 (A) shows. Drawing 9 (B), (C), and (D) are the explanatory views showing the condition of having projected the test pattern of 4 dots shown by sign 34a of drawing 3 on the CCD component. the image recorded by the ink droplet on space -- each dot -- ** -- although it is circular, an uneven blot condition is shown somewhat. Drawing 9 (B), (C), and (D) are drawings

showing the condition that the image in the record paper of the test pattern which consists of 4 dots shown by 34a of drawing 3 was projected on the CCD component. As for 34c of drawing 9 (B), ink shows the condition of having bled greatly, as for 34e of the image of a standard blot condition, an example with few blots to 34d of drawing 9 (C), and drawing 9 (D). In this example, it changed into the digital data with the A/D converter in which the output of each pixel of a CCD component is shown with the drawing 4 sign 50, and has inputted into the controlling mechanism 53.

[0029] Next, as the sign 62 in drawing 5 shows, a test pattern image reading result is processed and an amendment means is determined. At this example, it is processing with software by the controlling mechanism shown with the sign 53 of drawing 4.

[0030] A processing result performs a setup of a recording head drive wave, and a setup of the record data expansion approach, as the drawing 5 sign 63 shows. In this example, the expansion processing setting device 46 connected to the drive wave setting device 47 connected to the recording head driver 44 according to the controlling mechanism 53 in drawing 4 and the data expansion device 42 is set up.

[0031] Next, record data are developed as the sign 64 in drawing 5 shows. It is developed by the expansion approach previously set up by the data expansion device shown with the sign 42 of drawing 4, and record data are stored in the record dot data memory 43.

[0032] Next, as the sign 65 in drawing 5 shows, it records. By the recording head driver 44 which had the drive wave previously set up according to the data stored in record dot data memory by drawing 4, a recording head 2 is driven, a record image is recorded on recording paper 8a which is shown by drawing 2 and on which the test pattern is recorded previously, and next door record is completed in the condition of sign 8b.

[0033] The test pattern image at the time of previous test pattern record remains outside a record section, as drawing 2 sign 22b shows, but since the test pattern is recorded outside the data storage area in addition to being minute area, an observer does not discover the marks where the test pattern was recorded, unless it observes in a detail.

[0034] Since record data and a test pattern are recorded on the record medium same as a record result according to this approach, when there is much ink discharge quantity, a minute test pattern cannot be formed but the quality of a record result will be spoiled. Then, as a result of conducting the experiment which records by changing the ink discharge quantity of 1 dot in this invention, and carries out organic-functions evaluation of the record result, when the ink discharge quantity of 1 dot was below 0.1microg, it turned out that it is satisfactory. Therefore, ink discharge quantity of 1 dot is set to 0.03microg in this example.

[0035] Moreover, even if the ink discharge quantity of 1 dot is below 0.1microg, when there is much area of a test pattern, the remains of test pattern record are conspicuous, are observed, and may spoil a record result. As a result of recording the test pattern and record data to which the magnitude of the image part which continued about this was changed variously together and carrying out organic-functions evaluation of the record result, when the magnitude of the image of the continuation field in one place of a test

pattern was the magnitude settled in the circle which is the diameter of 0.3mm, it turned out that it is satisfactory. Moreover, as a result of evaluating the amount of ink per unit area in this case to coincidence, when making the amount of record dots of a test pattern below into 3micropor direction product of 1mm 4 g, the good result was obtained with almost all record media. Therefore, in this example, as lateral magnitude is indicated to be 0.06mm, 0.1mm, and 0.14mm to the signs 33a, 34a, and 35a of drawing 3 , respectively, the magnitude of a test pattern is considering as the test pattern of the magnitude which goes into the circle which is the diameter of 0.3mm, respectively enough.

[0036] Drawing 6 explains the art of the test pattern image reading result in this example.

[0037] A/D conversion of the signal from a CCD sensor is carried out for every pixel, and it is changed into the digital value according to the quantity of light, respectively. In this example, at the time of proofreading of a reading system, black level is detected in 103 parts, a white level is detected per pixel in proofreading pattern 102 part of the proofreading plate of drawing 10 , further, the white level of the detail paper is detected from the amount of reflected lights before record of the detail paper, it reads in each pixel unit of CCD, and the threshold of decision of the white/black of a result is determined. The reading result of a test pattern image is the pixel unit of CCD with the sign 71 of drawing 6 , and when higher [than a threshold] and lower than white and a threshold, it processes as black. In this example, the dot pattern of 31a of drawing 3 is detected first, the number of pixels of the black on CCD is counted with the sign 72 of drawing 6 , and it considers as the area of an independent dot test pattern. The signs 32a and 33a of drawing 3 are processed similarly, and the test pattern of the set dot of 34a processes the area of a pattern with the sign 73 of drawing 6 similarly. Moreover, the test pattern of sign 35a of drawing 3 counts the number of pixels of the white part surrounded by the amount of Kurobe with the sign 74 of drawing 6 , and makes it the area of an inside NUKE part. Each area value measured above is processed according to the decision Ruhr set up by software with the sign 75 of drawing 6 . An expansion art is set up, when, adjusting the amount of dots of an ink droplet as a result and adjusting the expansion art of record data for a setup of a drive wave. In this example, the above-mentioned decision processing is realized using the software of both a recording device and a host computer.

[0038] Drawing 11 , and 12 and 13 explain how to adjust the amount of dots of the ink droplet in this example. At this example, the approach of pressurizing ink using the piezoelectric device of the structure shown in drawing 11 , and carrying out the regurgitation from a nozzle is used, and discharging of ink is performed by impressing the voltage waveform shown in the terminal of a piezoelectric device 116 at drawing 12 . That is, since it is distorted in the direction which inter-electrode [of a piezoelectric device] extends by charging a piezoelectric device 116 in the section of Tc0, and making the electrical potential difference between terminals high if it explains in the voltage waveform 121 of drawing 12 , the pressure wall 115 connected in the direction

which goes to it direct by drawing 11 draws ink in the pressure room 112 from the ink supply way 113 in this actuation that bends in the direction which extends a pressurized room 112.

[0039] Next, the electrical potential difference of a piezoelectric device is held in the part shown by Th of drawing 12 . Next, when [this] discharging the charge of a piezoelectric device in the section of Td, a piezoelectric device releases distortion of the point, by drawing 11 , since it returns in the direction which contracts the pressure room 112, ink serves as an ink droplet from a nozzle 111, and the pressure wall 115 carries out the regurgitation. It is known for the record component of such structure that will draw with the amount of drawing in to the pressure room of ink by changing the time amount which extends a pressure room, a rate will change, and discharge quantity will change. That is, in the applied-voltage wave to the piezoelectric device of drawing 12 , if it shortens like Tc1 which shows the usual charging time Tc 0 with a broken line 123, the discharge quantity of an ink droplet will increase, and if the charging time is lengthened like Tc2 shown with a broken line 122, ink discharge quantity will decrease.

[0040] Drawing 13 shows the drive circuit of the recording head of this example. A sign 116 is a part to which the part to which the part surrounded with the piezoelectric device of a recording head and the broken line of a sign 131 impresses an electrical potential difference to a piezoelectric device, and carries out charge and discharge, and the part surrounded with the broken line of a sign 132 switch each piezoelectric device. A circuit carries out charge by constant current to the criteria capacitor Co from the part surrounded with the broken line of a sign 133 by inputting a control signal into Terminal Tsc, and charges a piezoelectric device 116 through Tr2 according to the potential of the criteria capacitor Co. Moreover, the charge of the criteria capacitor Co is discharged in the part of a sign 134 by inputting a control signal into Terminal Tsd at constant current, and discharge of a piezoelectric device 116 is carried out through Tr2. The control signal added to terminals Ts1 and Ts2 performs ON/OFF of each drive of two or more piezoelectric devices 116 connected to the circuit 131. Therefore, since the charging time shown by drawing 12 Tc can be changed by changing the resistance of resistance 135 part which has determined the charging time to the criteria capacitor Co in the drive circuit diagram 13 , adjustment of the amount of dots is possible.

[0041] In this example, it is considering as the structure of controlling connection to resistance 135 by the switches 136s and 137s according the resistance 136 and 137 connectable with juxtaposition to a relay, and changing resistance to it with them. In this example, since a setup of a drive wave of all piezoelectric devices can be performed in control of said resistance, the configuration of a driver circuit is easy.

[0042] Since the recording apparatus of the ink jet method which pressurizes ink using a piezoelectric device like this example can change ink discharge quantity comparatively simply by changing the drive wave of a piezoelectric device, and the change width of face of discharge quantity is also stabilized about 30 percent and is changed to it in the amount of ink, it fits adjustment of the amount of dots of this invention. Moreover, the property by which fluctuation of the load of a driver was stabilized few compared with

the method which changes a drive electrical potential difference in adjustment of the amount of dots is acquired.

[0043] Drawing 6 and 7 explain adjustment of the data expansion approach in this example. When the blot condition and repeatability are judged to be close to a standard record condition from the reading result of a test pattern in this example, although record is performed with a criterion, a setup of a drive wave of a recording head, and a setup of the record data expansion approach. When blot condition and repeatability are separated from reference condition (for example, when there is more blot condition of a test pattern than a criterion), the drive wave of a recording head is adjusted, the amount of regurgitation dots is lessened, and the condition of the image recorded is made into reference condition. However, when the blot condition and repeatability of a test pattern are judged to be greatly separated from a standard record condition, in addition to adjustment of the amount of dots by modification of a drive wave, the record data expansion approach is changed, and it is made for the image recorded to approach a standard record condition. For example, when it is judged that the image recorded even if the amount of blots of a dot adjusts the amount of dots greatly from the record condition of a test pattern fewer than a criterion will not be in standard condition, it is lessening dot density which changes and records a setup of the expansion art of record data, and the image recorded is adjusted to standard condition.

[0044] In this example, modification of the gamma characteristics used when developing record data performs adjustment of the image-processing approach. Although record data including halftone are given with a RGB value etc. from a host computer, since the modulation of the amount of dots in a pixel unit is impossible as a recording device, dithering which modulates the number of record dots per record area performs gradation record. Although the record dot density per area will be modulated in 64 steps when the number of gradation which can carry out dithering in this example is made into 64 gradation, the average concentration in the record paper recorded by it becomes what changed with amounts of dots of the ink breathed out from a recording head.

[0045] The record concentration on the space at the time of carrying out 64 steps of dithering to drawing 7 (A) by this example, and recording gray scale is shown. A sign 82 is a property in case the diameter of a dot is a criterion, and a property when a sign 81 has a large diameter of a dot, and a sign 83 are properties when the diameter of a dot is small. If the diameter of a dot changes so that it may understand in a graph, although the concentration value reproduced by the whole will change, it turns out that the form of a graph also changes with it. although the concentration which the step value of dithering increases to 64 from 0 and which is alike, and is followed and recorded increases in a graph, the middle and upper right part are resembled and the part whose graph is no longer a straight line exists. This is the phenomenon in which are generally called dot gain, generate when the dot and dot which were recorded as the step value of dithering increased and went begin to contact, and concentration increases rapidly. The graph of drawing 7 shows that the location which the concentration value recorded not only changes, but dot gain generates changes, when the diameter of a dot of a record dot is

changed.

[0046] Drawing 7 (B) is a graph which shows a setup of the gamma characteristics for determining the step of dithering from the gradation value given as record data in this example. The sign 85 is set up so that the recording characteristic of the dot gain which is a property in case the diameter of a dot is a criterion, and was explained previously may be offset. After changing concentration data into a dither step value with this property, if it records on space, the gradation value given as record data will be reproduced almost faithfully by the property of the dither step value-record concentration shown with the sign 82 of drawing 7 (A) on space.

[0047] In this example, when the diameter of a dot becomes a criterion by changing the drive wave of a recording head and changing the amount of dots based on the reading result of a test pattern, the data expansion approach is good with a criterion, but even if it changes a drive wave, when the diameter of a dot does not become a criterion, a standardization of the reappearance concentration value by modification of the data expansion approach is further needed. However, not only adjusting the concentration property at the time of image expansion simply also in that case but the whole concentration transfer characteristic needs to be adjusted. Since the record result concentration by gradation data changes the location of dot gain by change of the diameter of a dot as the graph of drawing 7 (A) shows, as the signs 84 and 86 of drawing 7 (B) show, it is changing the whole gamma characteristics including amendment of dot gain, and record repeatability is improved.

[0048] As mentioned above, in this example, without using the form for test patterns, since record data are recorded on the record medium with which the test pattern was recorded, amendment doubled with the actually recorded quality of paper can be performed, and always good image reappearance is attained. Moreover, time amount of the ** sake for test pattern record and reading was able to be made into the minimum that a test pattern is the same as a record medium with the actual record medium of a test pattern, and easy, and by equipping the same carriage as a recording head with test pattern detection equipment.

[0049] In addition, according to this invention, it is not necessary to necessarily take the same configuration as the above-mentioned example, and software may realize and functions, such as various memory including test pattern developmental mechanics, the processor of a test pattern reading result, the setting device of a drive wave, the setting device of expansion processing, etc., an expansion device, a processor, and a setting device, may be realized by hardware. Moreover, even if each function is on the host computer which may be in a recording device and is connected, it is not cared about. Moreover, each part may be realized independently and each function may be realized integrative. Moreover, although the recording device of the above-mentioned example has adopted the recording head which used the piezoelectric device, this invention is effective also in recording devices using the ink jet record component by the piezoelectric device, such as a recording head which used the thermal element. Moreover, amendment of a record image may adjust only the amount of ink dots, and

may adjust only the data expansion approach, and is good also by those combination.

[0050] Test patterns other than the above-mentioned example are explained below.

Drawing 14 is a test pattern especially effective in the recording device of this invention. The test pattern the test pattern of 1 dot and signs 142 and 143 were excluding the test pattern of an ensemble dot (2 dot x2 dot and 3 dot x3 dot), and excluding [signs 145 and 146] 1 dot of cores of 3 dot x3 dot and 5 dot x 5-dot ** respectively in the sign 141, and signs 147 and 148 are the test patterns except core 2 dot x2 dot (4 dot x4 dot and 6 dot x6 dot), respectively. the result recorded since neither of the patterns needed much area -- since -- it is suitable for this invention at the hardly known point. Furthermore, since any pattern has a concentric circle-like form mostly, detection with a test pattern image detection means and processing of a detection result can be performed easily.

[0051] The test pattern of 1 dot of a sign 141 is easiest pattern that the blot condition of the ink in paper understands, and its degree of freedom of a test-record location is high. the blot condition of the ink in paper being known, simultaneously a dot are connected, and the description of the direction understands the test pattern of the ensemble dot of signs 142 and 143. Moreover, since record area is large, measurement of the average concentration at the time of solid record is easy. Furthermore, it is also possible to detect the absorption degree of the ink of paper from the difference of the blot condition of the independent dot 141 and the blot condition of an ensemble dot. Although there is an inclination for the adjoining dot comrade to pay ink well, and for ink to crawl or flow, in record in an OHP form, in such a case, the description of how to crawl ink or image formation is detectable. Inside NUKETESUTOPATAN of signs 145, 146, 147, and 148 can detect how many inside NUKE parts will be crushed according to an osmosis operation of ink, when a record medium is paper. Moreover, in the case of an OHP form etc., it is turned out whether while being based on the inquiry of ink, crushing of a NUKE part occurs. In addition, even if it uses test patterns other than the test pattern shown above, there is no change in this invention being effective.

[0052] Drawing 15 is the result of recording two or more test patterns containing the test pattern shown by drawing 14 by the approach of this invention, and carrying out organic-functions evaluation of the record result using two or more test subjects. The "pattern" of the drawing 15 (B) table is equivalent to the sign of the test pattern of drawing 14 , and an approximate dimension is the width of face of each pattern, the test subject to whom "probability of detection" discovered existence of a test pattern from the print sample of A4 size on which the test pattern is recorded by the approach of this invention is (%) comparatively, and it shows the evaluation as the aforementioned print sample of "evaluation" being total respectively in five steps. According to this, no test subjects discovered test patterns 141 and 142. Therefore, there is no fall of evaluation by having recorded the test pattern outside the record section, and it has brought the evaluation result 5. Moreover, the rate to which a test subject discovers a test pattern increases as test patterns 143, 145, 147, 146, and 148 and the magnitude of those become large, and evaluation falls with it. It is drawing 15 (A) which made [many] the result of the above organic-functions evaluations, took the measurement size of a test

pattern, and made the evaluation value the graph.

[0053] If that it can consider from these results has minute it even if it discovers existence of a test pattern, I hear that evaluation does not fall greatly and there is. Moreover, since a test pattern is recorded in fact, the image is read and data are recorded using the optimal amount of dots for a record medium, or the expansion approach, if it takes into consideration that the alphabetic character in a record section and the quality of an image improve compared with the case where a test pattern is not recorded, it will be thought that the fall of evaluation by existence of a test pattern becomes small further. These results showed that especially the advantage that records a test pattern by the approach of this invention was large, when the size of a test pattern was 0.3mm or less.

[0054] Drawing 18 is an example which shows test pattern image detection means other than said example. The sensor of said example is divided in the shape of a concentric circle by this example as compared with having been divided into the grid pattern. Sign 181 in drawing a is [the sensing field of the shape of a ring of the perimeter and sign 181c of the sensing field near a core and sign 181b] the sensing fields of the perimeter further. Although the sensor of this example is also applicable also to test pattern reading of a set dot, an inside omission pattern dot, etc., it is suitable for reading of test patterns, such as a comparatively easy independent dot.

[0055] It is the description that reading of the blot information on a dot is possible for a test pattern detection means by which the sensing field was divided in the shape of a concentric circle when it was an easy test pattern at the small number of sensors, and the precision at the time of reading is also high. Moreover, since a dot tends to become the property than to which near and an illumination system, and optical system also attached greater importance to the circular field at a circle, it reads, and the configuration of a system is also easy a dot. Moreover, since there are few reading results, processing can be done simply. A means to read a test pattern image in the field divided on the other hand in the shape of [which was used in the previous example] a grid has the advantage to which evaluation of a complicated test pattern including information, such as a location of a pattern and a form, is attained, while a configuration becomes complicated, since there are many fields which carry out sensing. Moreover, even if the test pattern for reading has shifted from the core of a sensor, it has every advantage which can be read.

[0056] Drawing 19 is an example which shows the decision art in the case of detecting the test pattern image of 1 dot, changing the drive wave of a recording head according to the blot condition on a record medium using a test pattern detection sensor with the field of the shape of a concentric circle shown in drawing 18 , and setting up the amount of regurgitation dots mostly or few. In this example, decision processing by the software which changes the output value from each field into 16 steps of digital value using the test pattern detection sensor shown in drawing 18 , and is shown in the procedure of drawing 19 is carried out. The example of the reading condition of a sensor in case how depending on which the standard dot of this example bleeds in drawing 18 (B) is shown is shown. All the dot images of the test pattern projected on the field a of the core of a

sensor are the black of an ink color, and are 16 about the digital value. A part of ink image is projected on the field b of the perimeter, the value is 10, the outermost field c does not almost have the image of ink, and the value is 1. Similarly, as for drawing 18 (D), drawing 18 (C) shows the case of being larger than a criterion, when [with few blots of ink] the diameter of a dot of a test pattern is smaller than a criterion.

[0057] The flow chart of drawing 19 is what shows the process in which a setup of a head driver is judged from the output value of said field of a, b, and c. In decision of signs 192, 193, 194, and 195 from the output of each detection field The dot image of a test pattern has the composition of judging whether it being detected normally, judging the magnitude of the dot detected with signs 196 and 197, and setting up a head driver with signs 198, 199, and 120.

[0058] Next, the recording head of a recording device and the physical relationship of a test pattern image detection means by this invention are explained.

[0059] In said example, as drawing 1 shows, it is in the location with the virtual shaft top record-medium front face of a recording head 2 and the test pattern detection means 1 which shows the Records Department of a test pattern, and a detecting element with the signs 2c and 1c in drawing, respectively at which it crosses, and each of the scan locus exists on the same line parallel to the main scanning direction shown with the sign c in drawing. Therefore, in this example by this invention, the sensor unit 1 is correctly movable to a test pattern image detecting element only by moving carriage 3 after record of a test pattern. That is, since it is not necessary to operate carriage in the direction shown with the notation b which is the direction of vertical scanning in this example, while detection of a test pattern can be performed correctly, reading actuation of a test pattern is made to a high speed.

[0060] Drawing 16 and drawing 17 are drawings showing the configuration of the recording device by this inventions other than said example. The carriage 163 which read the example shown by drawing 16 with the recording head 162 like the example of drawing 1 , and attached the sensor 161 moves to a main scanning direction 11 along with the carriage guide 166, and the recording paper 168 is a recording device of structure sent in the direction 12 of vertical scanning with the paper feed roller 165. The record location and test pattern reading location of a test pattern in this example are located in the location at which virtual shaft 162c of a recording head 162 and virtual shaft 161c of the test pattern reading sensor 161 cross a record medium 168, respectively, and are on one line parallel to the direction 12 of vertical scanning which the both sides show by sign 12c. Therefore, actuation which moves from record of a test pattern to reading can be performed only by migration of the recording paper 168, without moving carriage 163. The example shown by drawing 17 is a recording device which twists the record form 178 around the drum shown with a sign 175, and is recorded by the recording head 172.

[0061] Record actuation of this example is the approach of moving a recording head 172, rotating a drum 175, and the sensor unit 171 for test pattern detection is attached on the recording head. Therefore, the scan locus on each record form 178 of the location

which records a test pattern by the recording head 172 on virtual shaft 172c which is the migration direction of the carriage which the hand of cut of the drum which a main scanning direction shows with the sign 15 in drawing by this example, and the direction of vertical scanning show with a sign 16, and is shown by a diagram, and the detection location of the test pattern detection means 171 on virtual shaft 171c is on the same line c parallel to a main scanning direction 15. Therefore, also in this example, the migration actuation between record of a test pattern and reading requires only rotation of a drum, and actuation in a short time is possible, securing location precision.

[0062] in addition, if it reads with the record location of a test pattern, and the scan locus on the record medium of a location is alike on the same line parallel to a main scanning direction, or it reads with a record location and the scan locus of a location is on the same line parallel to the direction of vertical scanning, since the actuation through which reads in record of a test pattern and it passes is good at migration of only a main scanning direction or the direction of vertical scanning, the same effectiveness will be acquired also in the recording device of the configuration of those other than the above-mentioned example.

[0063] Although the proofreading pattern of the test pattern reading means shown by the drawing 1 sign 4 and drawing 10 is used for proofreading of a sensor in said example, you may use as criteria of processing of the reading result of a test pattern further. That is, the test pattern, and the same dot and an inside NUKEPA turn are printed as a standard test pattern, and it is good also as a configuration which judges the blot condition on the space of ink etc. by comparing with the test pattern recorded on space. Since evaluation of a test pattern can be performed only by the relative comparison with a standard test pattern in ** if it is made this appearance, the output value of a test pattern detection device does not need to take into consideration the technical problem of changing according to the environmental temperature of a recording apparatus, or aging, and the easy configuration of it is attained.

[0064] Although the location which records a test pattern in said example was used as the upper right part of the record section on a record medium, if it is outside the record section of data according to this invention, it is obvious that there is same effectiveness. Moreover, although the record section of data was detected from record data and the test pattern record location was determined in said example, the fixed location of the outside of the field which is notified to the host computer etc. and defined as it as a record section of a recording device may be made into approaches, such as always considering as a test pattern record location. recording a test pattern on the field rather, since the several mm circumferential edge of a record medium is made into the outside of a record section in the prevalent recording device in many cases -- record data -- referring to -- a test pattern record location -- each time -- determining -- ** -- having said -- a process -- the need -- being lost .

[0065] When the recording device by this invention uses not only when the usual paper is used for a record medium, but a thing with the blot property of different ink from the usual forms, such as recycled paper and a synthetic paper, and the record medium with

which there is almost no blot like an OHP form, and an ink droplet cannot sink in easily, it is effective. Moreover, the recording device by this invention is effective also in the recording device which does not make a record medium a final record result. For example, after once recording the record image by the ink jet component on the record medium on a drum or a belt and performing desiccation etc., it is effective also in the recording device of the method imprinted to record media, such as the recording paper.

[0066]

[Effect of the Invention] As mentioned above, as explained based on the example, according to this invention, a minute test pattern is recorded outside the record section on a record medium. By taking the record process of record for the record image based on record data on the record medium with which detection of a test pattern image, adjustment of the ink discharge quantity by the detection result or adjustment of the data expansion approach, and a test pattern were recorded Record good to all record media is attained without using many record media for test pattern record. Moreover, since record of a test pattern is performed on the record medium which actually records, grasp of a record-medium property is exact, and can make the minimum time amount which record of a test pattern image and detection take.

[Translation done.]